Measurement of Photon + Z to b-bbar at CDF

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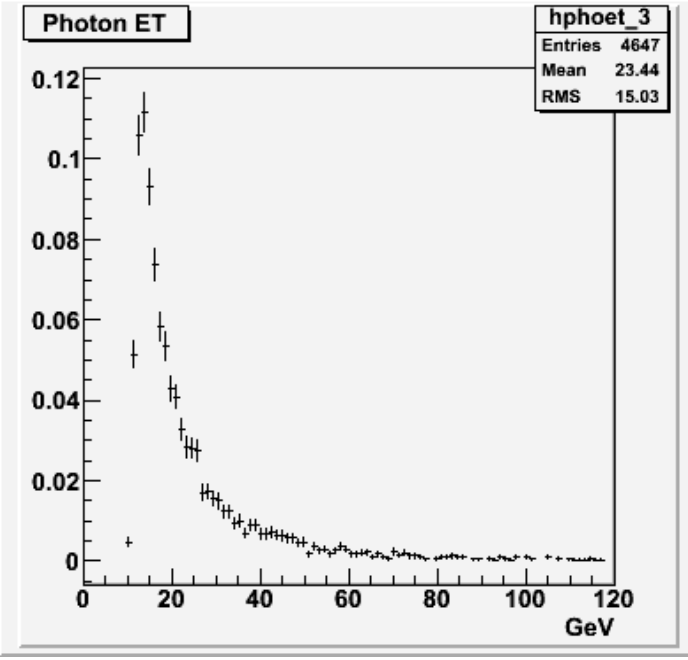
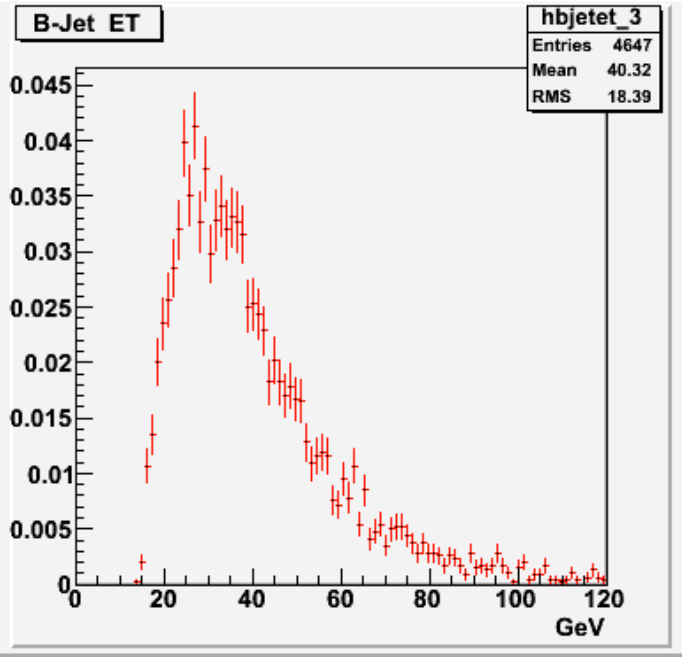
Overview

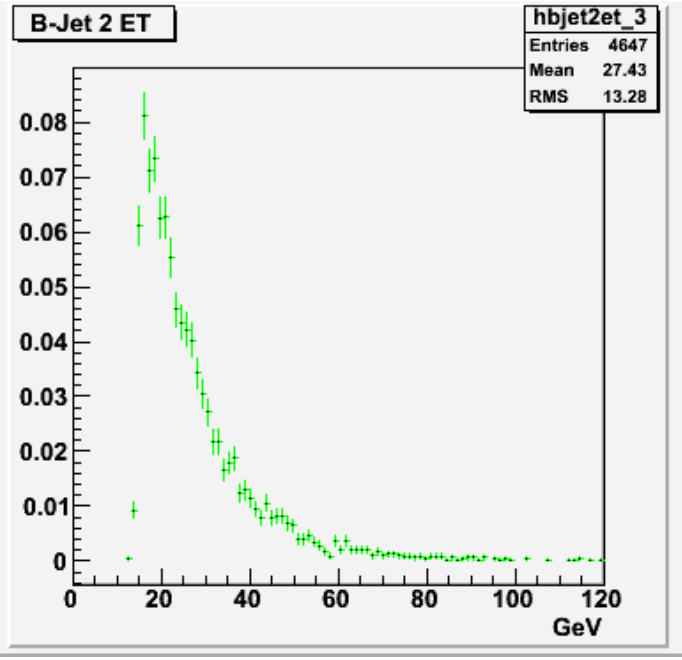
- Study of Z boson + photon production in CDF data
- Standard Model process observed previously in the channel Z-->ll
- Focused on determining the source of background events, studying the trigger efficiencies, and training a neural network
- Inclusive photon data

Data Kinematics

- Transverse energy of gamma, leading b-jet, and secondary b-jet
- Analysis cut on phoet at ~20 GeV, bjetet at ~25 GeV, bjet2et at ~20 GeV

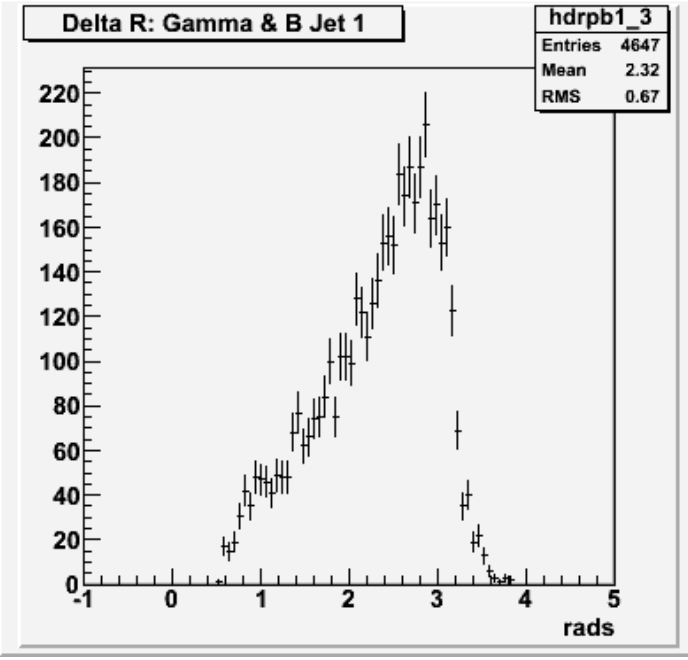


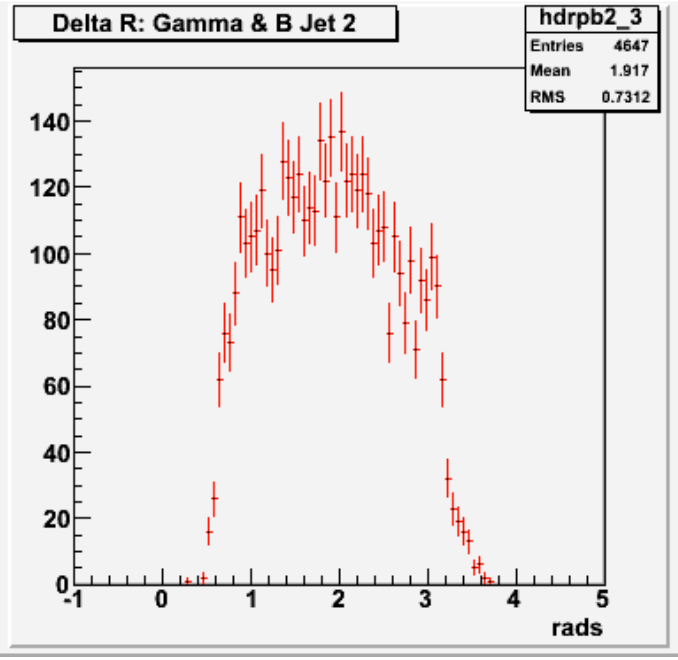


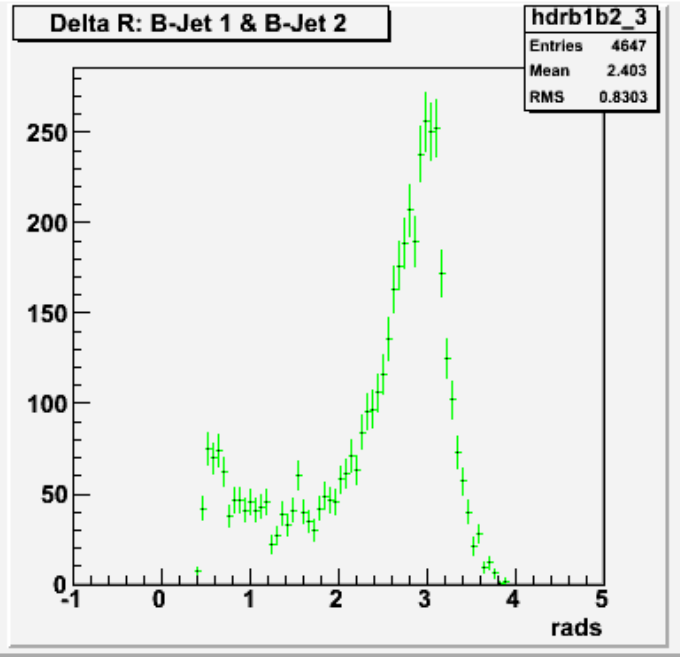


Kinematic Cuts

- ΔR between gamma and each jet
- ΔR between both jets
- Analysis cut on $\Delta R_{gb1} > 0.7$ and $\Delta R_{gb2} > 0.7$





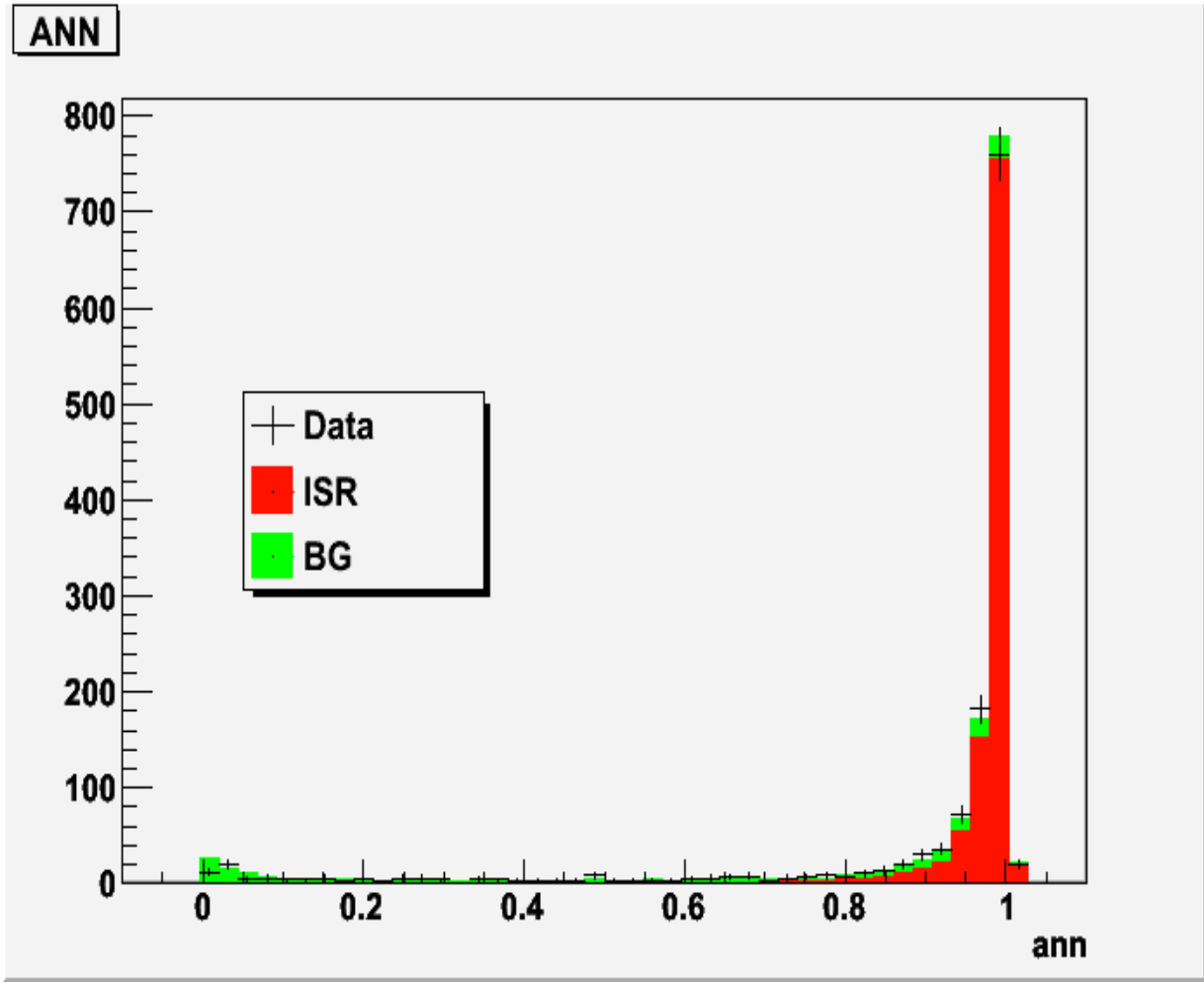


Background Sources

- pi^0 fakes a photon, other processes that emit γ
  - π^0+b+b
  - π^0+b+j
- Jet is a non b-jet.
  - γ+b+j
  - γ+j+j
- b-bbar not a result of Z decay

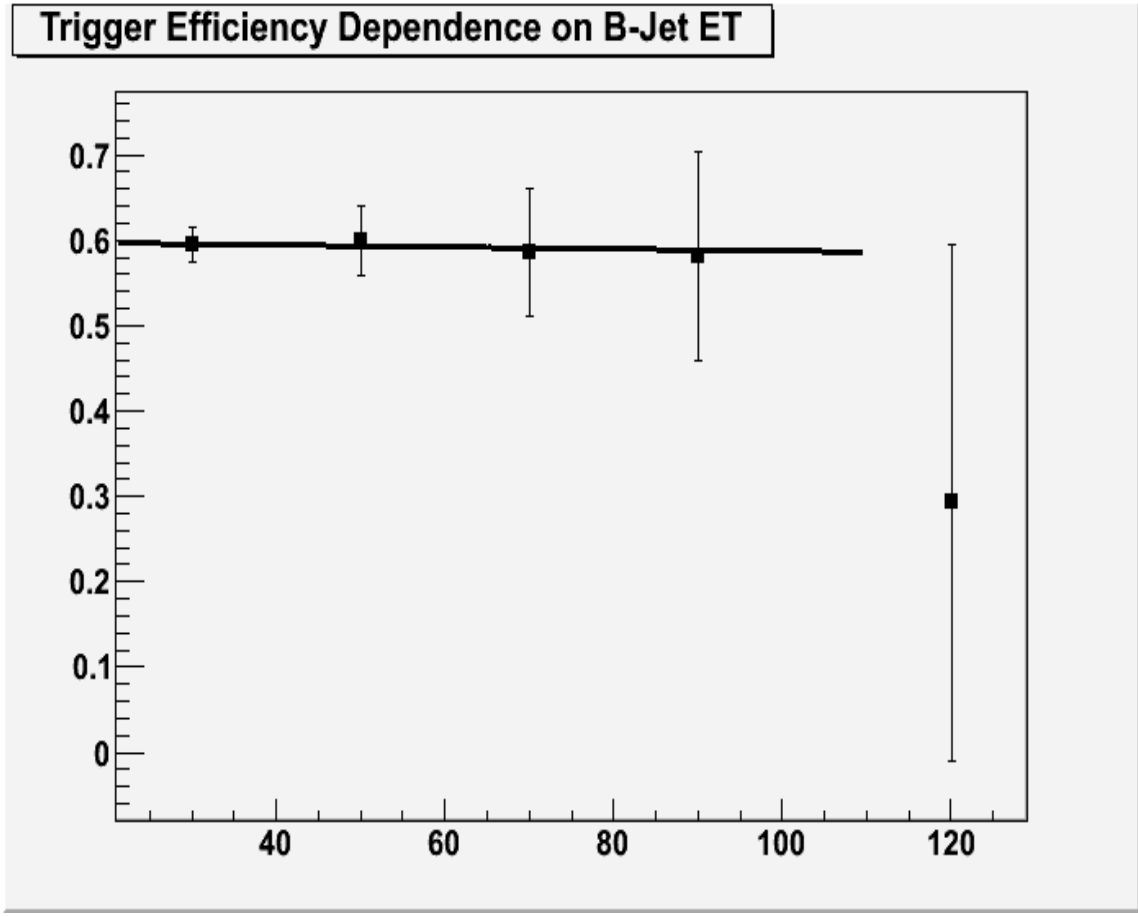
Photon Background

- Plot photon ANN for signal and background MC.
- Fit data to templates.
- Determine signal fraction ~91%.
- Majority of background not due to fake photons



SVT Trigger Efficiency

- MC does not have an SVT trigger requirement.
- Determine trigger efficiency as a function of bjetet.
- Apply this function as a weight to MC events.
- MC models data more accurately.



Signal Prediction

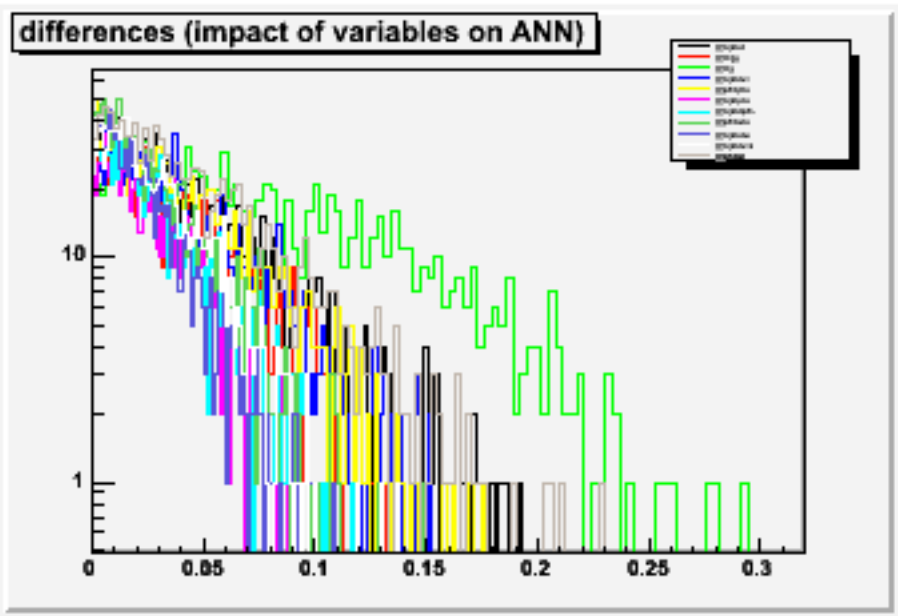
- Generated cross sections using MadGraph
- Number of predicted events P
- Total number of events N
- Number of signal MC events n
- P = σ*lum*n / N

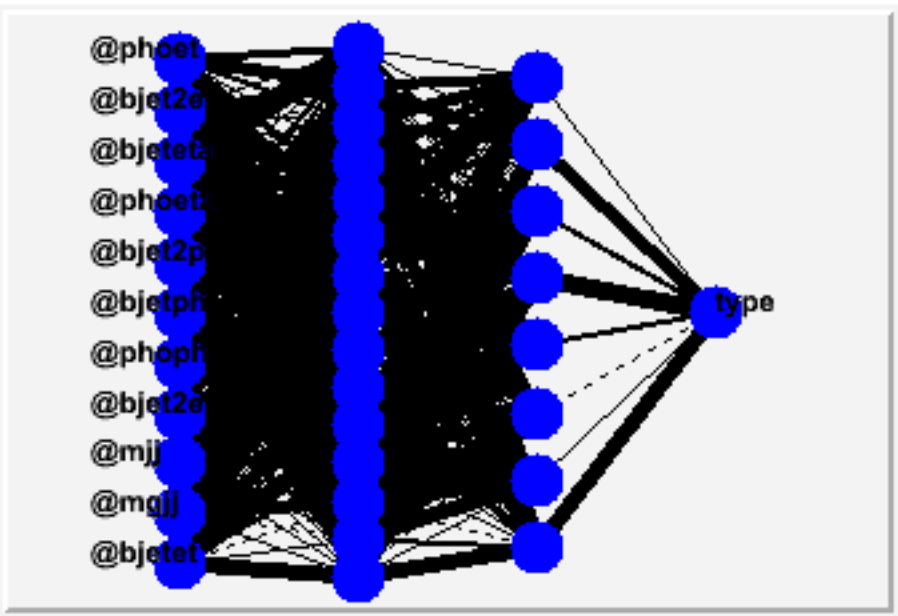
Cuts on Et (GeV)	ISR	FSR	BG	Data
γ > 15 bjet > 25 bjet2 > 20	37.04	5.27	935.4	2270
γ > 20 bjet > 25 bjet2 > 20	25.26	2.26	632.9	1411
γ > 25 bjet > 30 bjet2 > 25	14.92	0.42	329.2	668
γ > 25 bjet > 40 bjet2 > 30	10.33	0.12	205.0	424

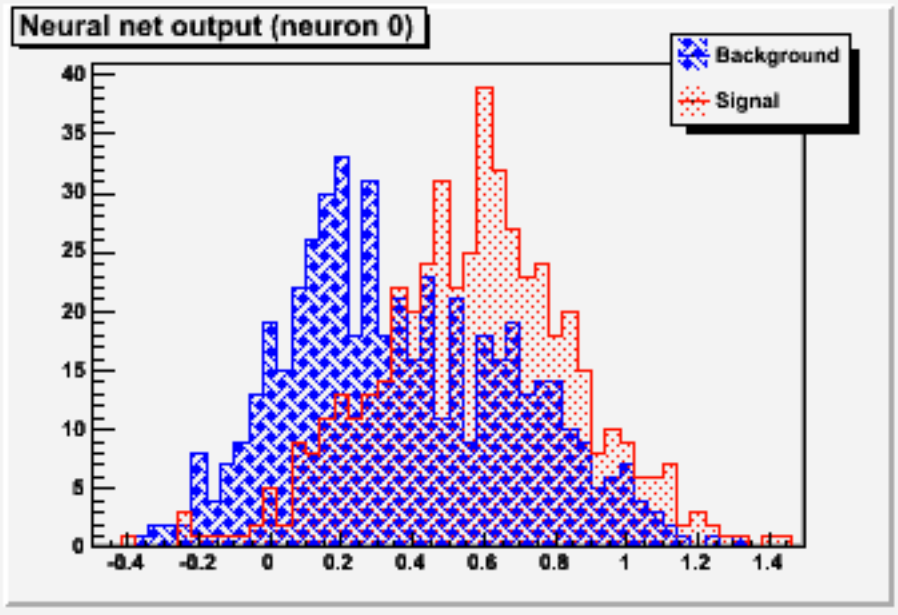
More MC

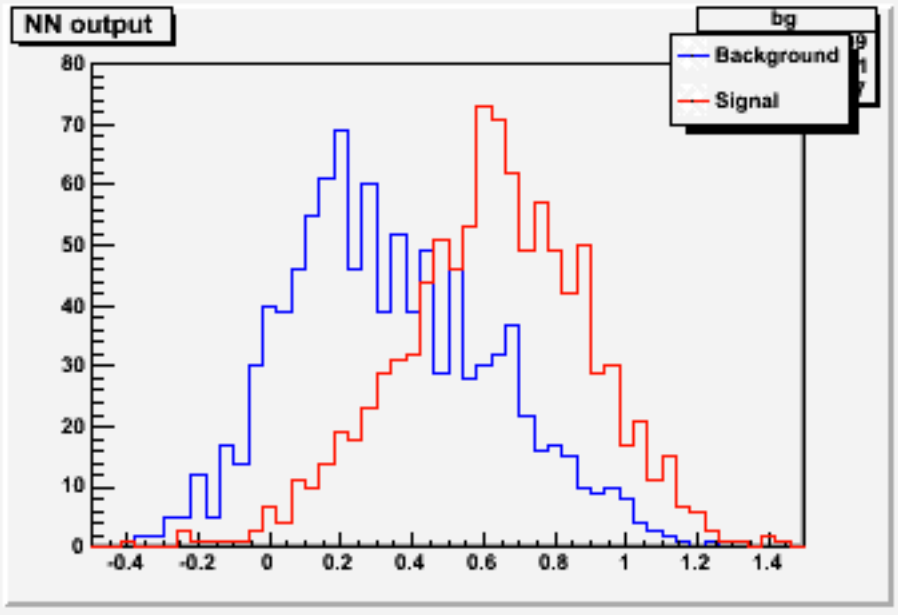
- Low statistics in background MC, large error
- Generated more background MC
- Include channel gamma + b-bbar + jet.
- Retrain neural network.
- Recalculate cross sections and signal predictions.
- Refit data.

Neural Network

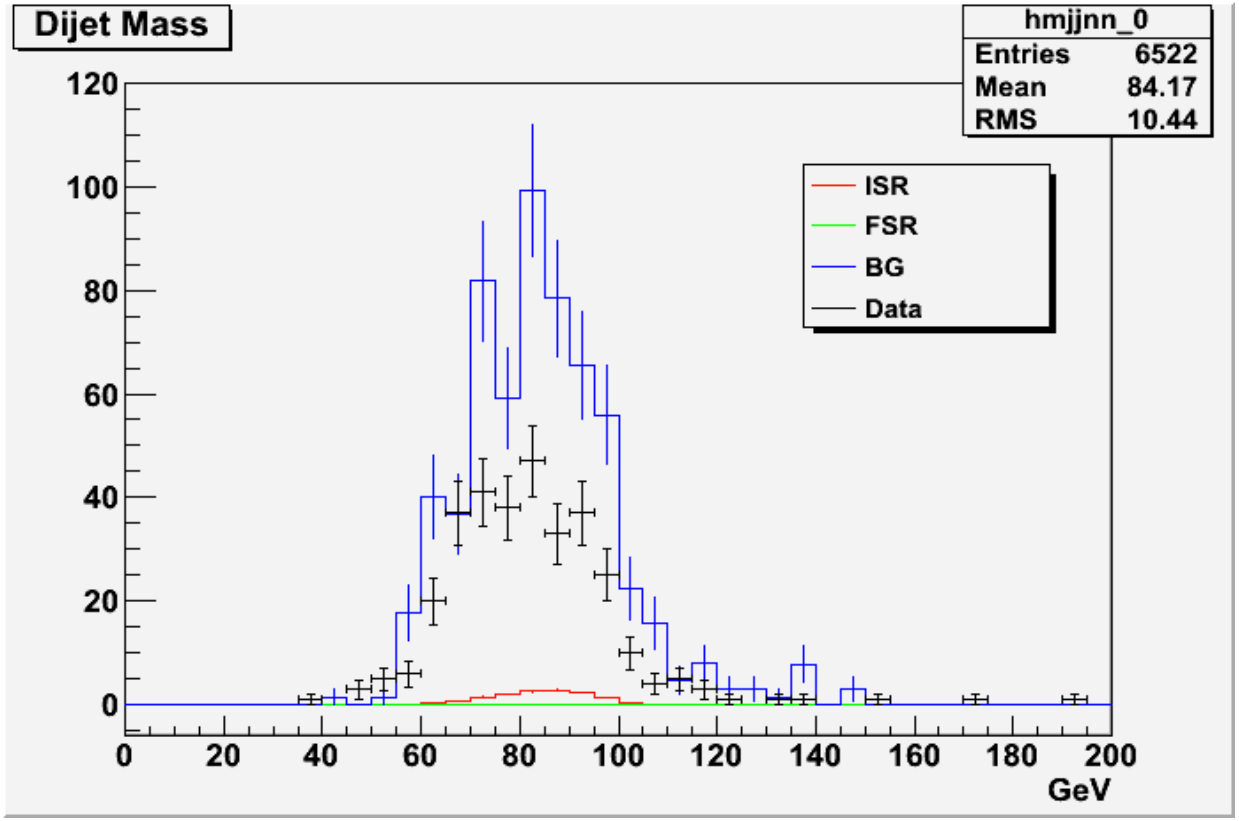








Signal Predictions

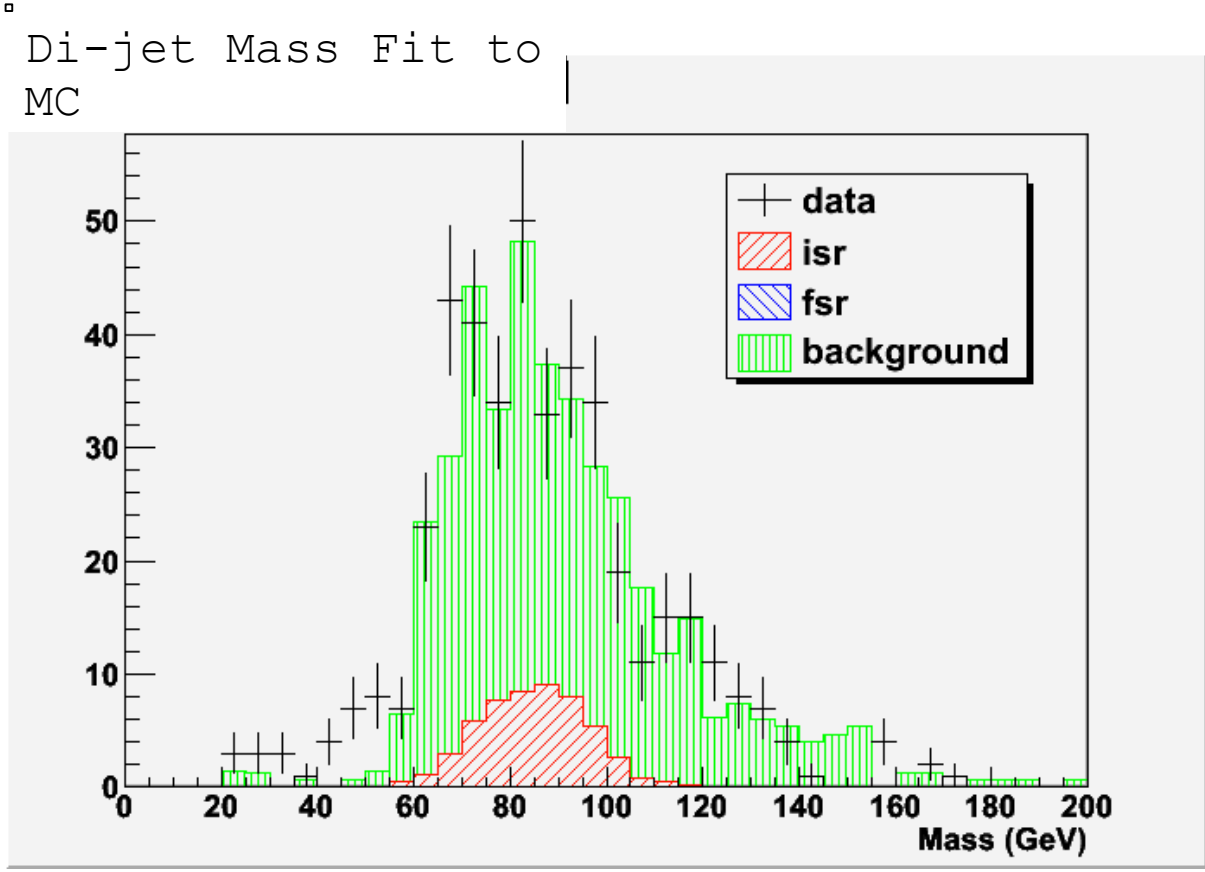


- Generally, our signal predictions fall within the range of the measurements' error.

Cuts	ISR	FSR	BG	Data
phoet > 15, bjetet > 25, bjet2et > 20	21.9	1.9	1000	574
phoet > 20, bjetet > 25, bjet2et > 20	15.2	0.7	607.9	321
phoet > 25, bjetet > 30, bjet2et > 25	9.27	0.14	340.5	178
phoet > 25, bjetet > 30, bjet2et > 20	10.5	0.22	380.4	211
phoet > 25, bjetet > 40, bjet2et > 30	6.67	0.06	228.4	117

Results

- Final TMinuit fit with additional MC and all cuts (kinematic, trigger, nn)
- Signal: 53.5288 ± 39.6943
- BG: 351.553 ± 43.4642
- Data: 429



Conclusions

- Z decay is observed—substantiates SM process.
- However, error is large.
- Need more MC to improve the statistics.
- Broad distribution of signal events centered around 90 GeV
- Final state radiation events do not contribute to signal measurement.